# EC441: Homework 2

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# 1 Textbook Problems

Problems from the book

**Problem 2.23**

**Question 1)** if $t_{dist} = \frac{NF}{u_s}$, then the server's upload time dominates the client's slowest download time.

**Question 2)** if $t_{dist} = \frac{F}{d_{min}}$, then ther client's slowest download time dominates the upload time of the server.

**Question 3)** The minium distriubution time cannot be faster that the larger of the server's upload time or the slowed client download time, and thus $t_dist \geq max\{\frac{NF}{u_s}, \frac{F}{d_{min}}\}$.

**Problem 3.3**

$$\begin{array}{r} 01010011 \\ 01100110 \\ +01110100 \\ \hline 00101101 \\ + \qquad\quad 1 \\ \hline 00101110 \end{array}$$

**Problem 3.13** The only time that there are two packets on the link simultaneously is when there is an premature timeout on the side of the sender. In that situation, the sender will send the timed-out packet again, while the acknowledgement is still traveling to it. If packets can be re-ordered on the link, then the acknowledgement packet will arive before the re-sent packet. The receiver will discard the duplicate packet and the sender will accept the ack packet, and the outcome of the premature time out will be unaffected by the packet swap.

**Problem 3.19** INsert figure here

**Problem 3.22**

**Part 1)** $k$ can be at either the front or the back of the window, e.g. $\{k-3, k-2, k-1, k\}$ or $\{k, k+1, k+2, k+3\}$, so the range should be $[k-3, k+3]$ or seven different numbers.

**Part 2)** The maximum range of Ack values is equal to the sender's windwos size. This is because the receiver will only acknowledge the last received packet and does not acknowledge out of order packets. Thus, the receiver only needs to keep up with the packets in the sender's window.

**Problem 3.24**

**Part 1)**

**Part 2)**

**Part 3)**

**Part 4)**

# 2 Additional Questions

Extra Questions here

**Additonal Question 1** Description of the first addition Question